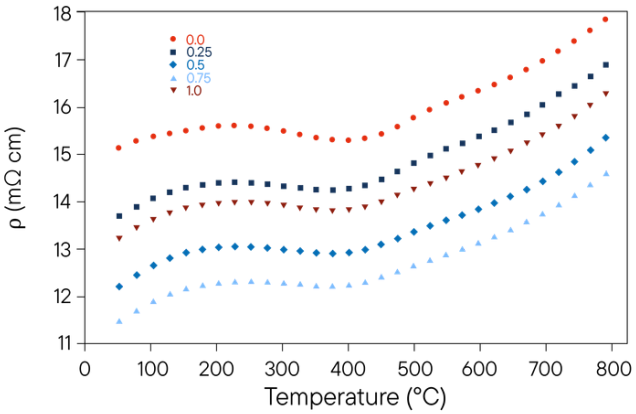
Electrical Resistivity of TiC-Doped $Ca_3Co_4O_9$ Thermoelectric Ceramics

LSR L33 High-Temperature Electrical Resistivity Analysis

Electrical resistivity is a key parameter for evaluating the performance of thermoelectric materials and directly influences their energy conversion efficiency. In this study, the LINSEIS LSR L33 was used to characterize the temperature-dependent electrical resistivity of TiC-doped $Ca_3Co_4O_9$ ceramics. The measurements demonstrate the influence of TiC additions on charge transport behavior and provide valuable insight into the optimization of oxide thermoelectric materials.

Measurement Setup

- Instrument: LINSEIS LSR L33
- Material: $Ca_3Co_4O_9$ + x wt.% TiC
- Temperature Range: 50–800 °C
- Atmosphere: Helium
- Measurement: Electrical Resistivity
- Application: Thermoelectric Materials



The electrical resistivity measurements reveal a clear influence of TiC addition on charge transport.
Key observations include:

- Reduced resistivity with TiC addition
- Lowest resistivity at 0.75 wt.% TiC
- Stable high-temperature behavior
- Improved electrical conductivity

The results demonstrate the effectiveness of TiC nanoparticles for enhancing electrical transport in oxide thermoelectric ceramics.

Interpretation

The observed behavior can be attributed to:

- Improved charge transport
- Reduced grain-boundary resistance
- Uniform TiC dispersion
- Optimized microstructure

This results in:

- Lower electrical resistivity
- Improved thermoelectric performance
- Enhanced material efficiency

Industrial Relevance

Electrical resistivity measurements support:

- Thermoelectric generators
- Waste heat recovery
- Energy harvesting
- High-temperature ceramics
- Power generation
- Functional materials

Conclusion

The LINSEIS LSR L33 enables precise characterization of electrical resistivity over a wide temperature range. The measurements demonstrate that optimized TiC additions significantly improve the electrical transport properties of $Ca_3Co_4O_9$ ceramics, providing valuable information for the development of efficient thermoelectric materials and high-temperature energy harvesting applications.

Source:
Amaveda, H., Dura, O. J., Mora, M., Torres, M. A., Guelou, G., Madre, M. A., Marinel, S., Sotelo, A.
Tuning $Ca_3Co_4O_9$ Thermal and Transport Properties by TiC Nanoparticles Addition.
Boletín de la Sociedad Española de Cerámica y Vidrio, 2020.
Adapted from electrical resistivity measurements performed using a LINSEIS LSR L33 (formerly designated as LSR-3).